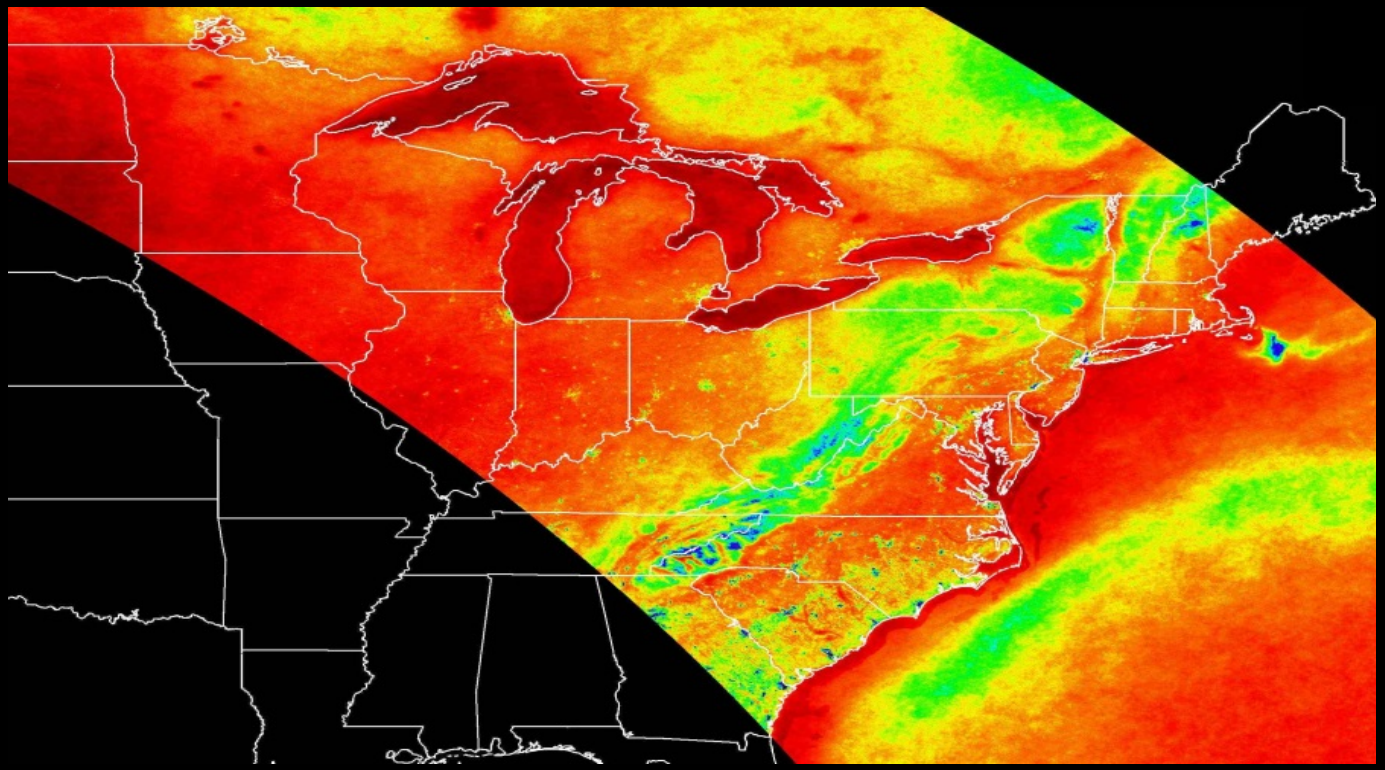
Cloud Impact on Landsat Surface Observations:

An Assessment Based on a Decade of Daily Terra MODIS Observations



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Global Science & Technology, Inc.

ET Workshop 2015

DEPARTMENT OF GEOGRAPHY AT THE UNIVERSITY OF MARYLAND, COLLEGE PARK

Background

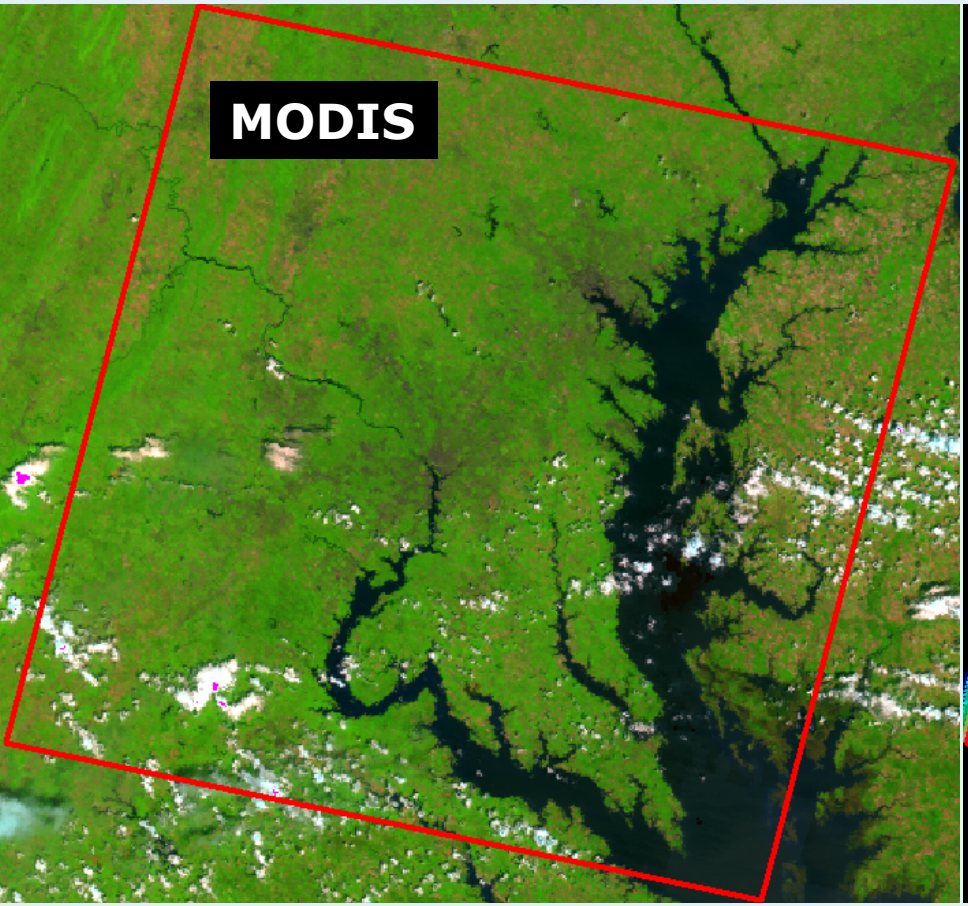
- **A primary goal of Landsat is to "periodically refresh a global archive of Sun-lit, substantially cloud free, land images."** ***Frequent repeat imaging is critical to achieve this mission*** **– Why?**
  - **because cloud contamination is the first order issue in passive optical land imaging**
- **4-day repeat was goal of Landsat visionaries (Pecora et al) but never achieved**
  - **tandem op's of Landsat's 5 & 7 yielded 8-day repeat or ½ the original vision**
  - **8-day repeat 'kind of' continues with Landsat's 7 & 8, but Landsat 7 op's will end long before Landsat 9 is placed in orbit**
  - **question remains "*What repeat frequency is needed for successful imaging?*"**
- **10 yrs of daily Terra MODIS observations were analyzed to quantify Landsat repeat frequencies needed to overcome cloud contamination.**
  - **MODIS and Landsat 7 image same areas within 30 min of each other**
- **Study goal was to quantify probability of acquiring 'cloud-free' imagery, or ability to create a cloud-cleared composite over specific time intervals (e.g., weekly, biweekly, monthly, seasonally) by simulating observatory configurations with imaging repeat frequencies ranging from daily, to every 2 days, 4 days, 8 days, & 16 days.**

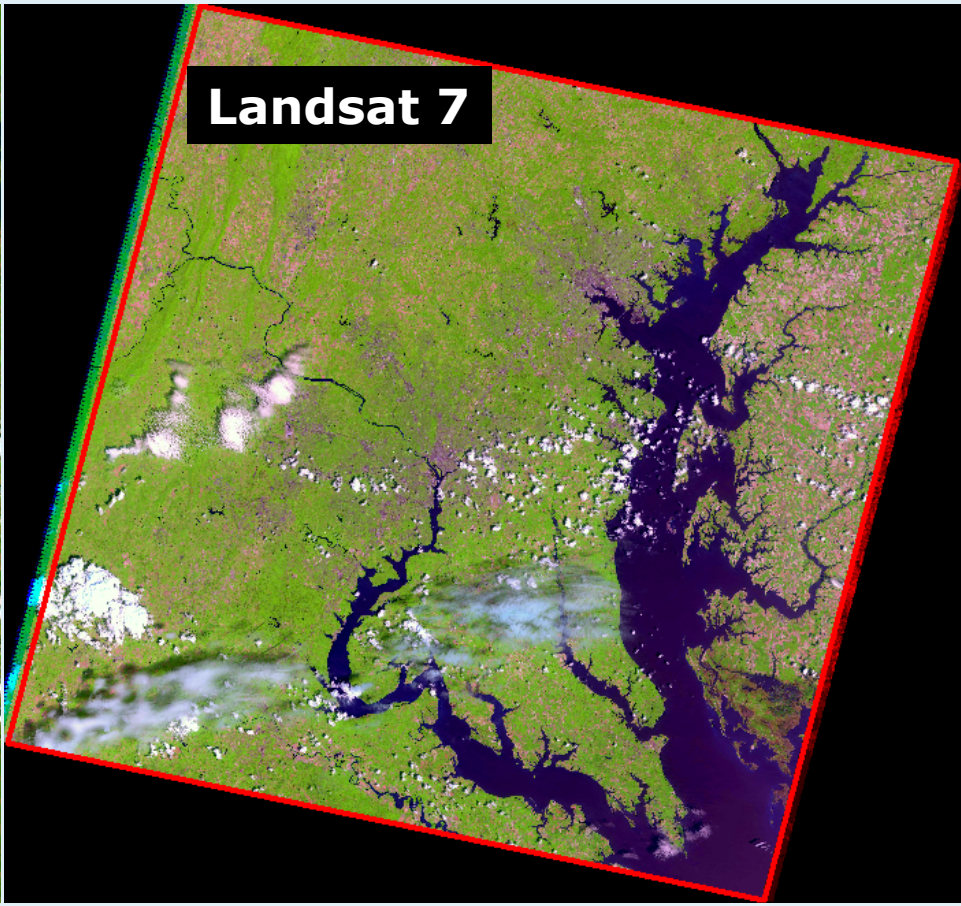
Journal article summarizing this research currently under review at Remote Sensing of Environment.

Cloud Cover in MODIS Image Chip vs Landsat WRS

June 02, 2002

MODIS and Landsat 7 image same areas within 30 min of each other





Overarching Conclusions

- **Results indicate that the probability of acquiring clear views is a near-linear function of imaging repeat frequency.**

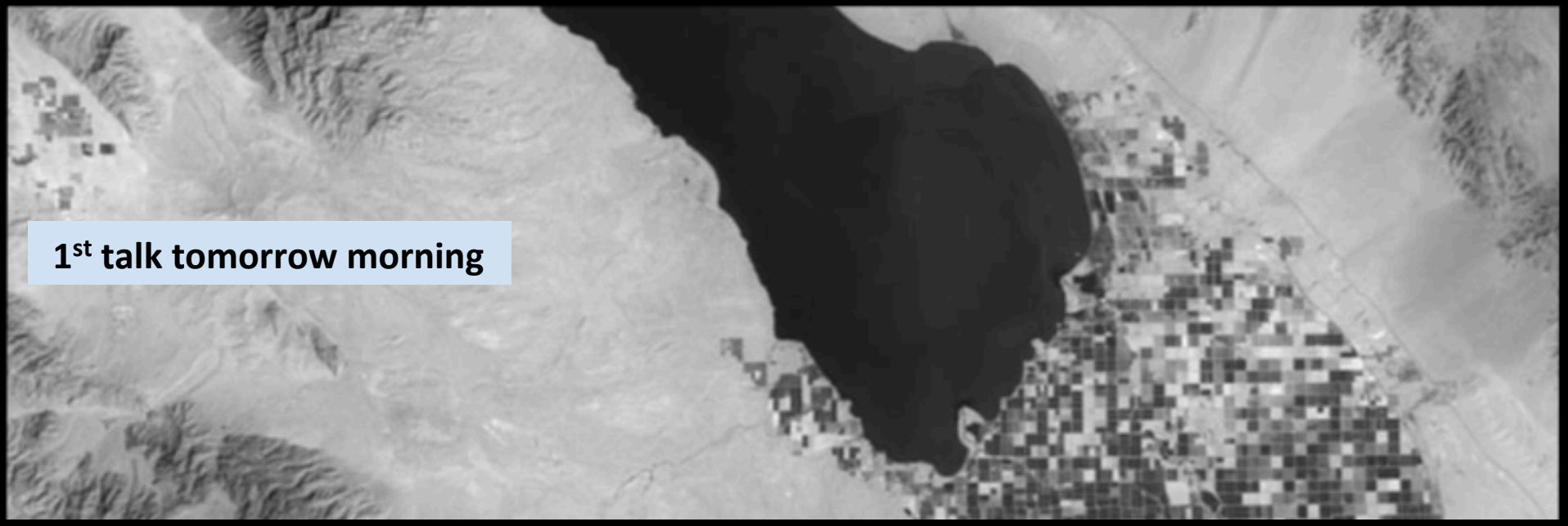
Repeat Cycle	Reliable Clear Views
1 day	Weekly
2 days	Bi-weekly
4 days	Monthly
8 days	Seasonal (quarterly)
16 day	Annual (sometimes)

- **More Landsat-like observatories are needed in orbit simultaneously.**
- **Referring here to 'Landsat-like' because at nearly $1B per copy for current designs, we will be lucky to get one mission approved every 10 - 15 years -- history has shown this to be the case.**
- **There are now much lower cost smallsat-based imaging solutions that can yield high quality data and could be used to enhance imaging frequency and remove the ever present threat of a crippling data gap.**

Small-Sats and ET Mapping

Role of Smallsats for ET retrievals:

Potential ~~and Limitations~~



1st talk tomorrow morning

Dr. Darrel Williams

Global Science & Technology, Inc. (GST)

2015 International Workshop on Evapotranspiration Mapping for Water Security

September 15-17 / The World Bank / Washington, DC

Summary Thoughts

- ***"Smallsat technology has progressed far enough (that) … there is no technical reason why smallsats can't equal the performance and reliability of traditional satellites"*** … observation by Dr. Bryant Cramer (New Millennium Prog Mgr)
- ***"Why are we only building and launching IBM 360 mainframe computer equivalents in an era of laptops, IPAD's and smart phones?"*** observation by Prof Samuel Goward (UMD)
- **IMHO, a smallsat solution should be embraced immediately as an *augmentation* to Landsat 8 and 9**
  - adding such a mission **would yield more frequent coverage** and **serve as relatively low-cost insurance against a crippling data gap**
  - if shown to provide acceptable performance, as we expect, **smallsat solutions should become the new norm for sustained land imaging**
- **Smallsat potential for reliable ET retrievals is high;** the predominant limitations are out dated perceptions and politics

SMALLSAT SOLUTIONS CAN PROVIDE SCIENTIFICALLY VALID DATA RIGHT NOW!